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Cost-Benefit on Masculination of NILE TILAPIA (*Oreochromis niloticus*) using Natural and Artificial Hormone

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Abstract

The study was conducted to estimate the cost benefit of using wet testes of bull *(Bos. indicus*), boar *(Sus.domesticus),* bull/mud catfish testes (*B.indicus / C. gariepinus)* and pawpaw seed powder (*Carica papaya*) on masculinization of Nile tilapia (*Oreochromis niloticus)* fry in an indoor experimental pond. The estimates of cost effectiveness of producing phenotypic males were determined after 4months. A total of 825 fry were randomly allocated to 15 experimental ponds. The hormonal diets were formulated by adding 17α- methyl-testosterone (MT) T1, wet testes from bull (T2), boar (T3), bull/catfish testes (T4) and pawpaw seed powder, PSP(T5) at an inclusion of 0.06g, 17.47g, 25.59g 20.48g and 20g respectively to 1000 g of feed . The fish were fed at 20% body weight during the 42 days feeding trials and a gradual reduction of feed from 10% to 5% during the 4months rearing period. The highest percentage (%) weekly survival rate during the 42 days feeding trial was observed in PSP (T5) 98 while MT diet (T1) had the least survival of 80. Result on external examination revealed that Nile tilapia fry fed with MT- treated diet (T1) gave the highest masculinisation of 100% followed by T3, T4, T2 and T5 with masculinization percentage of 93, 92, 89 and 80 respectively. Result on cost benefit showed that the highest gross income (Naira) was recorded in T5 (₦4860) and least in T1 (₦4050). Total production cost/kg was highest in T4 (₦5006) and least in T2 (₦3514). Total net return of fry was highest in T5 (₦1822) and least in T4 (₦ – 206). Basically, the results suggest that it is more economically viable to use PSP and testes from boar, bull in producing phenotypic male rather than the synthetic MT diet. Farmers should be encouraged to use natural hormone which could be of great relevance to organic tilapia production.

Keyword: wet testes, masculinization, hormonal diet, cost benefit, *Oreochromis niloticus*

INTRODUCTION

Nile Tilapia, *Oreochromis niloticus* is a commonly cultured fish species, although it is native to Africa but has successfully been introduced globally [1]. Nile tilapia is the most likely important cultured fish in the 21st century [2]. However, with the immense water resource in Nigeria, it remains worrisome that Nigeria does not have a thriving tilapia industry [3].Tilapia fish is generally accepted and eaten by many people but many aquaculturists are reluctant to culture tilapia because of the early sexual maturity, which results in: uncontrolled reproduction, over population; and retarded growth**.** About half a decade ago, 14.3 % of the world's human population (6.7 billions) was announced undernourished, and the global population is still expected to reach 9.3 billion by 2050 [4]. Fish production can be achieved in Nigeria by interest for tilapia farming whose culture has been taken over by catfish production.

The use of synthetic hormone such as 17α-methyltestosterone is the most common practice for many aquaculturists because it is considered efficient for masculinizing fry of various tilapia species [5; 6]. However, Synthetic hormones are expensive and not readily available in Nigeria. Thus, there is a major problem of finding a cheaper and natural substitute for masculinization of tilapia [4].Research on masculinisation of tilapia were obtained by using bull testis [7], testis from hog [8] and plant extract *Tribulus terrestris* to induce masculinization in *O. Niloticus* [9]. *Carica papaya* are bioactive phytochemical plants, rich with saponine [10; 11] and nowadays aquaculturists are using many types of extractions from these plants (seeds, leaves and pods) in masculinization of tilapia fish at different concentrations to avoid the use of 17α- Methyl testosterone hormone [12;13]. Pawpaw seed powder and *Moringa oleifera* have masculinization effect [14]. Pawpaw seed powder has been used to induce fertility in laboratory animals like rats [15] and rabbits [16].

Little literature is available on the cost benefit of using hormone from different animals and plant extract, which are relatively cheaper and available from local market and abattoirs within the country. The aim of this study is to determine the cost – benefit on the masculinisation of Nile tilapia (O*reochromis niloticus*) using wet testes, plant extract and 17α methyl testosterone.

MATERIALS AND METHODS

Feed preparation and sex determination

The study was carried out in 15 concrete experimental ponds at African Regional Aquaculture Center Aluu, (ARAC) Port Harcourt, Rivers State. A total of eight hundred and twenty

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five (825) fry of *Oreochromis niloticus* (Nile tilapia) were obtained as described by [17].

Wet testes of boar, bull and matured African mud catfish, 17α- methyl-testosterone, and pawpaw fruit were procured and prepared as described by ([17]. Five kilogram (5000g) of feed was formulated based on the working composition obtained from the feed mill of ARAC. 40% crude protein was used. The feed ingredient composed of soyabean, fish meal, wheat bran, cassava flour (garri), palm oil, and vitamin premix in various percentages as shown in Table 1. The formulated feed and hormones were prepared by adding 0.06g of 17α-methyl-testosterone (T1), 17.47g of bull wet testes (T2), 25.59g of boar wet testes (T3), 20.48g of bull/African mud catfish (T4) at (80:20), and 20g of pawpaw seed powder (T5) based diet respectively to 1000g of feed. The different hormonal feed used for the feeding trials are presented on Table 2. The Feeding trials were carried out in 15 concrete ponds ($1m^3x1m^3x1m^3$) with Fifty five (55) fry randomly distributed in five treatments with three replicates. The fry were feed at the rate of 20% of fish body weight during the 42days hormonal trial. Survival percentage in each treatment and replicates was done after the 42days hormonal trials using the formula as describe by [17]. Thereafter, the fry were fed with blood meal diet at 10% and 5% of fish body weight to 4months. The sex of fingerlings was determined at the end of 4months rearing period by examining their external genitals. Fingerlings were randomly removed from each replicate and sexed into males and females.

Table 1: Feed Ingredients and Treatment Compositions

Ingredients	%	Weight in 5Kg	Cost (Naira)
Wheat bran	30.73	1.54	70.84
Soyabean meal	14.31	0.72	110.88
Fish meal	42.94	2.15	1075
Cassava flour(garri)	5.00	0.25	42.5
Palm oil	5.00	0.25	96.25
Premix	0.25	0.013	25.60
Methionine	0.20	0.011	14.00
Vitamin C	0.1	0.005	15.00

Table 2: Hormonal inclusions in feed used for the trials

Hormonal Treatment feeds (T)	Concentrations /1000g of feed
Treatment 1(17α- methyl-testosterone)	0.06g
Treatment 2(bull testes)	17.47g
Treatment 3(boar testes)	25.59g
Treatment 4(bull/ catfish testes)	20.48g
Treatment 5(pawpaw seed powder)	20g

Cost Benefit

Cost benefit of the experimental diets, were determined using the gross income per 1000g of each diet, total operation cost per diet, and net return per diet in equations I, II and III respectively. The gross income (GI) was calculated by multiplying the total number of survived fry in each experimental pond by the assumed amount (30Naira) for selling fingerling. Total cost (TC) was calculated as the sum of all cost incurred on operation in each experimental pond.

$GI=TNF\times A$ Eqn.1
$TC=(x_1+x_2+x_3+.....)$ Eqn.2
Net return (NR) $NR = GI - TCO$..... Eqn.3

Where:
GI = Gross income
TNF = Total no of fry
A = amount of fingerling cost
TC = total cost
X = cost on operation
NG = net return
GI = Gross income

TCO = total cost on operation

Data Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 21. Analysis of Variance (ANOVA) were used to determine significant differences among treatments while Duncan multiply range test (DMRT) was used to determine their relationship and differences between treatment mean (±SE) at 5% level of probability.

RESULTS AND DISCUSSION

External examination on gonads

The result on the external examination of various treatments on masculinization result is presented in Table 3. It was observed that MT– treated diet(T1) had the highest male population (100%) followed by fry fed with boar testes treated diet (T3)with 93% while, the fry fed with bull testes treated diet (T2) had 92% masculinization. The fry fed with bull/catfish testes treated diet (T4) had 89% masculinization and the least was observed with fry fed with pawpaw seed treated diet (T5) with 80% masculinization. There were significant differences (at $p<0.05$) within the means of treatments. The external examination on the gonad (genital papillae) of *O. niloticus* showed little variation from the internal examination reported by [18].Mohamed [19] reported variation between internal and external result. He examined 50 fish from a group and the external feature showed that 40 fishes were male. After internal and histological examination of the gonads, He observed 42males, 7 females and one hermaphrodite. Hussain [20] and [21] reported that the sexual dimorphism of tilapia is expressed in genital papillae. They observed in their study that male genital has two openings while the female has three orifices which are usually flatter and shorter. During the time of sexing, few fish were less than 4g in weight and sexing of gonad at this stage is difficult

Cost benefit of production on experimental treatments

The cost benefits of production of the experimental treatments are shown in Table 4. The highest gross income (Naira) was recorded in T5 (₦4860) and least in T1 (₦4050). Total production cost per gram was highest in T4 (₦5006) and least in T2 (₦3514). Total net return of fry was highest in T5 (₦1822) and least in T4 (₦–206). The result in this study was not in line with their study [22] that reported the highest significant net return on MT treated diet and least net return on carabao and bull lyophilized testes diets, but is in line with their findings on raw boar testes which resulted in a high net return. From our findings, the total cost of production on animal testes was reduced as a result of cost incurred on purchasing wet testes from local abattoirs within the country. The results from this study suggest that T5 (₦1822) may be more economically viable alternative to MT which is not readily available and is an expensive method of masculinization. However, T4 had the highest cost incurred on operation; this was as a result of the cost of buying sexually matured catfish since the testes are not sold separately in the market. T5 had the highest net return which makes it more economical in this study. The result revealed that it is more economical to use bull testes, boar testes and pawpaw seed powder in sex reversing tilapia fry. However, MT hormone is more potent in masculinization of Nile tilapia. On the other hand, testes of bull, boar and plant extract (PSP) are readily available in local market and abattoirs. The use of wet testes and photochemical can be of great relevance to organic tilapia production

Survival Rate

The data on the weekly survival rate of Nile tilapia fry after the 42-day treatment period are shown in Figure I. Fry in T5 (98%) recorded the highest survival rate, followed by T2(93%), T3(95%), and T4(96%) respectively. The fish in T1 (80%) had the least survival rate. The high survival rate agrees with the findings of [14] who reported 96% survival rate using pawpaw seed. This might be due to the medicinal effect (i.e. saponins) found in pawpaw seed [23]. The high survival rate of Nile tilapia fry obtained in this study using wet testes from animals confirmed the findings of [24] who obtained high survival rates (88-95%) of fry fed with animal testes. Apparently, the survivals of fry during masculinization are dependent on factors such as stocking density, feeding, temperature and other environmental conditions [25]. The least survival in treatment I diet in this study is higher compared to [26] who reported survival ratio of 44% after 80 days trial of *Oreochromis niloticus* fry that was fed with 17 alpha-methyl testosterone (40mg/kg diet).

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Table 3: Sex ratio of *Oreochromis niloticus* on Hormonal treated feeds

PARAMETERS	TREATMENTS				
	T1(MT)	T2(BT)	T3(BO)	T4(BT/CA)	T5(PSP)
N	72	101	121	119	113
Male	24.00±2.00^{c}	30.00±3.46^{b}	37.67±2.08^{a}	36.67±1.53^{a}	30.33±1.53^{b}
Female	0.00±0.00^{d}	3.67±0.33^{b}	2.67±0.33^{c}	3.00±0.00^{bc}	7.33±0.33^{a}
%Male	100±0.00^{a}	89.14±0.26^{c}	93.40±0.76^{b}	92.43±0.17^{b}	80.05±1.10^{d}
%Female	0.00±0.00^{d}	10.85±0.26^{b}	6.60±0.76^{c}	7.57±0.17^{c}	19.50±1.10^{a}

Mean values in the same row with different superscript are significantly different ($p<0.05$) different by Duncan multiple range test
TI (MT) – Methyl-testosterone, T2 (BT) – Bull testes, T3 (BO) – Boar testes, T4 (BT/CA) – Bull/Catfish testes, T5 (PSP) – Paw seed powder, N – number of feed observed

Table 4: Cost benefit on production of hormonal treated feed

Items	Treatments				
	T1(MT)	T2(BT)	T3(BO)	T4(BT/CA)	T5(PSP)
Gross income	4050	4560	4740	4800	4860
Operation cost					
a. Diesel	288	288	288	288	288
b. fry	660	660	660	660	660
c. experimental diets	520	27	68	1518	50
d. hormone check	1000	1000	1000	1000	1000
e. ethanol	500	500	500	500	0
f. pond	200	200	200	200	200
g. transportation	840	840	840	840	840
Total cost	4008	3514	3556	5006	3038
Cost/fish	24.3	21.6	22	30.3	18.4
Net return	42	1046	1184	-206	1822

TI (MT) – Methyl-testosterone, T2 (BT) – Bull testes, T3 (BO) – Boar testes, T4 (BT/CA) – Bull/Catfish testes, T5 (PSP) – Paw seed powder

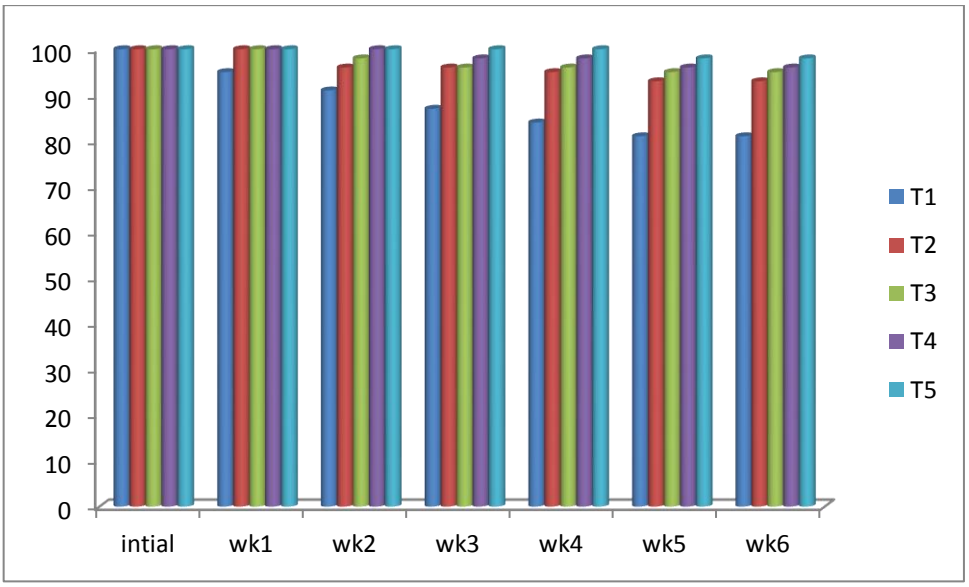

Figure I: Weekly survival rate (%) of Nile tilapia (*O. niloticus)* fry after 42days treatment period

CONCLUSION

The study was intended to see if natural hormone and plant extract can be an alternative to17 α-methyl testosterone in masculinization of tilapia fry and the cost benefit on production. After subjecting O*reochromis niloticus* fry to various sources of hormone for 42 days, it was observed that fry in T1 (MT) methyl testosterone had more males compare to T3, T4, T2 and T5 respectively. However, T5, T3, and T2 also had males but were less expensive to produce. The highest survival rate was observed in T5 and least in T1. Thus, T5 (PSP) and testes from boar, bull may be more economically viable in producing phenotypic male rather than the synthetic MT diet. Farmers should be encouraged to use natural hormone which could be of great relevance to organic tilapia production.

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